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General Mass Insertion Expansion in Flavour Physics

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Calculating amplitudes for the flavor changing transitions in terms of the off-diagonal elements of mass matrices (so called “mass insertions”) in the theory defined in “gauge basis” (before mass matrix diagonalization) is the common technique in analyzing the flavor structure of the New Physics models. I will present a general method allowing to expand any QFT amplitude calculated in the mass-eigenstates (physical) basis into series in mass insertions, to any required order. The presented method is purely algebraic, translating an amplitude written in the mass eigenbasis into mass insertions series without performing diagrammatic calculations in gauge basis. It can be applied for all types of mass matrices - either Hermitian (scalar or vector), general complex (Dirac fermions) or complex symmetric (Majorana fermions). In addition, proposed expansion has been automatized in the form of publicly available specialized Mathematica package,”MassToMI”, which I briefly describe. The package allows to obtain analytical expressions directly relating flavor observables to New Physics parameters without tedious and error-prone direct calculation of Feynman diagrams with mass insertions as additional vertices.

Summary

I will present an algebraic technique allowing to expand any QFT amplitude calculated in the mass-eigenstates (physical) basis into series in mass insertions, to any required order, without performing diagrammatic calculations with mass insertions. The method works for any type of mass matrices, either for scalar, vector, Dirac or Majorana fermion fields. It has also been automatized in the form of specialized Mathematica package.

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